TOWARDS A BLACK-BOX MULTIGRID WITH SMOOTHED AGGREGATION METHOD

M. Brezina[a], R. Falgout[b], S. MacLachlan[a,c], T. Manteuffel[a,d], S. McCormick[a,e], J. Ruge[a,f]

[a]University of Colorado at Boulder
Boulder, CO 80309-0526
brezina@newton.colorado.edu
[c]scott.maclachlan@colorado.edu
[d]tmanteuf@colorado.edu
[e]stevem@colorado.edu
[f]jruge@colorado.edu

[b]Lawrence Livermore National Laboratory
Livermore, CA
rfalgout@llnl.gov

Linear systems in engineering practice frequently arise from discretization of partial differential equations over unstructured meshes. Algebraic multilevel methods are becoming increasingly popular in the treatment of these problems because of their promise of optimal performance without the need for explicit knowledge of the problem geometry. These methods construct a hierarchy of coarse problems based on the linear system itself and on certain assumptions about the low-energy components of the error.

For smoothed aggregation methods applied to discretizations of elliptic problems, these assumptions typically consist of knowledge of the near-nullspace components of the weak form. For many classes of problems these components are known and can easily be incorporated into the transfer operators created during the multigrid setup precedure. However, situations arise in practical applications where this knowledge is either unavailable or obscured through certain handling of the linear system during the discretization process.

We describe a recently developed extension of the smoothed aggregation method in which good convergence properties are achieved in situations where explicit knowledge of the near-nullspace components cannot be relied upon. This extension is accomplished by submitting the method components to a test designed to determine troublesome components of the error when none are provided. The coarsening process is modified to improve and use computed error components.

The presented numerical experiments focus on problems of linearized elasticity.